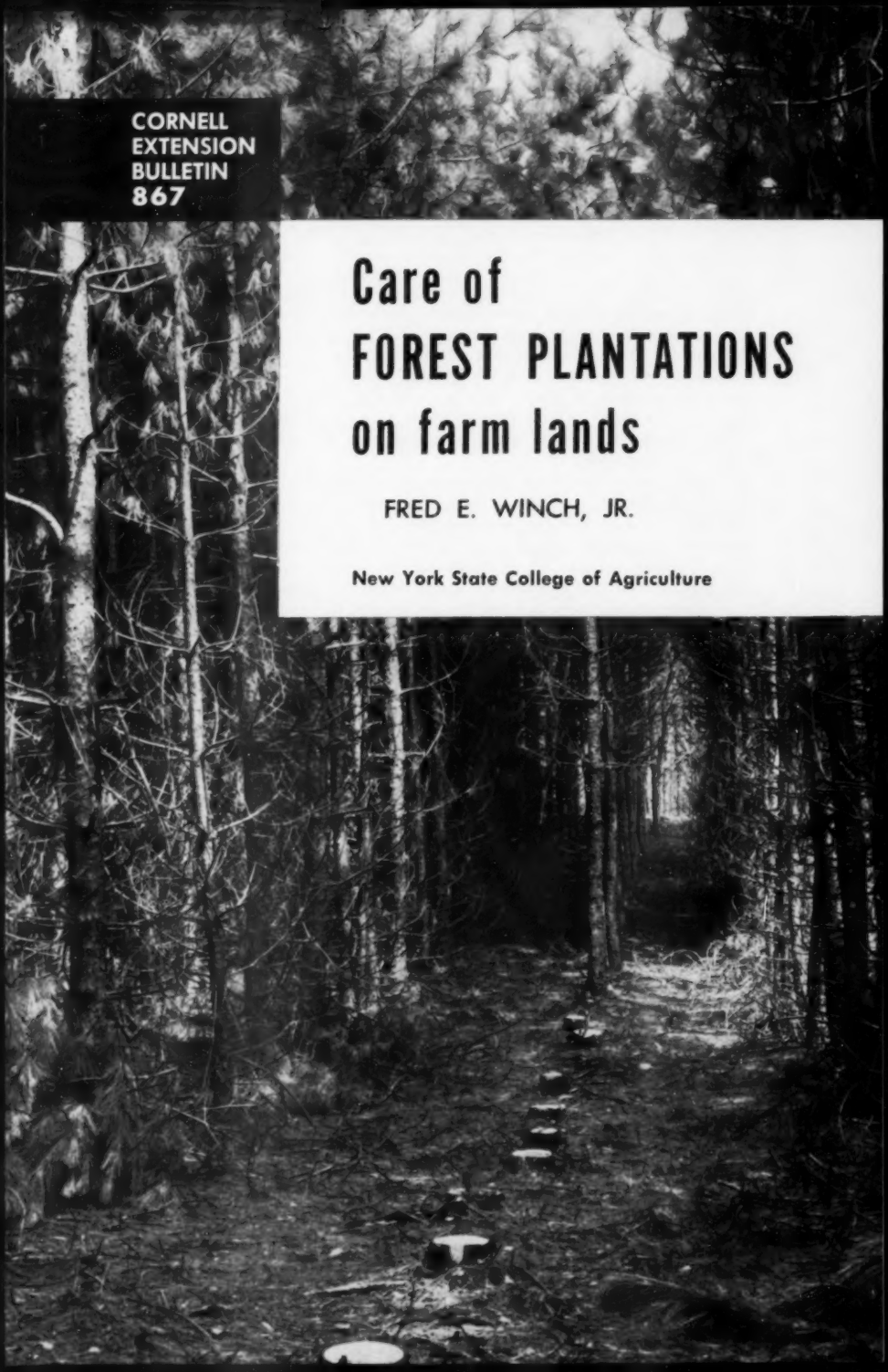

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Care of FOREST PLANTATIONS on farm lands

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Care of Forest Plantations on Farm Lands

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In 1908, the New York State Conservation Department first established its policy of making low-cost planting stock available from the state nurseries to farm land owners. It was not until the early 1920's, however, that there was any great demand for forest-planting stock. Since that time, there has been an increasing interest in reforestation of unused farm land. In the four decades before 1950, the total number of trees sent out from the State Conservation Department nurseries for small private plantings has totaled approximately 356,428,000, or enough to forest 356,428 acres, assuming that an average of 1000 trees was planted to the acre.

These planted forests on farm lands may be classified on the basis of ultimate use as: (1) Christmas-tree plantations, (2) production forests, and (3) windbreaks. The important steps in the establishment and early care of Christmas-tree plantations are considered and discussed in Cornell Extension Bulletin 704, *Christmas Tree Farming*. Plantations established to produce posts, pulpwood, and saw logs, likewise need culture and care while growing if the investment in time and money is to show an adequate and satisfactory return. In producing agricultural crops, seeding and planting must be followed by weeding and cultivating to assure maximum yields. So it is with your forest plantations. How to establish a forest plantation is described in Cornell Extension Bulletin 756, *Planting Forest Trees on New York Farms*.

If your plantation is to maintain the best growth throughout the years, follow these three practices:

1. **Weed**—remove the undesired trees in the plantation, usually hardwoods such as aspen, pin cherry, and thornapple.

2. **Thin**—reduce the number of stems per acre.

3. **Prune**—remove mechanically the side branches of the growing trees in the plantation.

The investment of time and labor in carrying out these practices in the early life of the stand usually brings satisfactory returns both in volume and value of your forest plantation.

WEEDING

Recommendations for establishing a forest plantation usually emphasize the use of open land (land on which natural seeding of trees is not already established) because existing hardwood growth competes seriously with the young seedlings. If a small amount of natural growth is already present, such as volunteer groups of pin cherry or popple, or a scattering of thornapple and wild apple, take these out before you plant the area.

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Even if you follow this practice, you may have a problem of stump sprouts from these inferior hardwoods which shade and compete with the growing trees. Hardwood seedlings that sometimes become established in the forest plantation after the seedlings have been planted are another problem. These may outgrow the conifers (the cone-bearing trees used for forest plantings in this State). You must remember that the heavier soils, which are common over much of New York State, are better adapted to the broad-leafed or hardwood trees than to conifers. The original forests of New York were for the most part hardwood in character. Consequently, under the shade brought about by the closing crowns (the spreading branches of the tree) of the young forest plantation, these hardwood seedlings become established and seem to grow far more vigorously than they do in bare, open land.

It is these conditions that require your first attention after the plantation is established. The time for you to weed is when it is obvious, on your inspection, that the volunteer growth—whether of sprout or seedling origin—is actually over-topping, shading, and mechanically injuring the young coniferous trees.

The simplest way for you to weed your planted trees is to go down the rows with an axe or machete and cut down the volunteer growth. At the time you cut these trees, treat the stumps of the cut trees with one of the newer chemical weed killers now available, such as ammonium sulphamate; 2, 4–D; or 2, 4, 5–T; or a combination of 2, 4–D and 2, 4, 5–T. These chemicals kill the stumps and root systems, and, as far as those particular trees are concerned, you will never have to weed again. Used properly, these chemicals are not poisonous to wildlife.[1]

The term *weeding* has been justly applied to this step in plantation culture because most of the invading hardwood trees are distinctly of weed character in comparison with the planted conifers. Valuable hardwoods, however, such as white ash or black cherry, may also be invading the plantation, not necessarily over-topping but growing along with the conifers. It is questionable whether you should remove these trees even if the nearby conifers suffer from the shade of the invaders. These species are, without question, some of the most valuable hardwood trees in New York, and will bring a much greater return per tree as a saw log than any of the planted conifers of equal age. *Only white ash or black cherry, of seedling origin, should be allowed in the plantation.*

The trees arising from the stumps of the recently cut trees should not be tolerated. If you cut the original growth of the plantation area before planting, and do not treat the stumps with chemicals, the resulting growth from these stumps will develop the so-called stump sprouts which will far out-strip the conifers in your plantation and will be valueless as far as timber trees are concerned. Weeding, then, is an approved practice that gives your young plantation conifers a chance to do their best in full sunlight. Usually, if you delay the weeding until the fifth to seventh year after planting, one trip through the plantation will be enough, especially if you treat the stumps to prevent sprouting.

THINNING

Thinning is another cultural practice that finds a parallel in agriculture. The gardener sows vegetable seed thickly in the row. Germination is excellent, and

[1]Cornell Extension Bulletin 1001, *Killing Undesirable Woody Plants with Chemicals,* gives complete directions for use.

unless he thins the stand of plants, there will be few marketable vegetables. Forests established by planting contain far more trees per acre than can possibly survive as saw-log trees, because such trees must be tall and slender with long, log-producing trunks and few branches. For example, the conventional spacing of 6 by 6 feet, recommended when most of the older forest plantations were established, actually requires 1210 trees to an acre. Yet, at the age of 60 years, it would be an unusual stand of pine that supported more than 300 trees to the acre. More trees than would compete for sunlight, food, and water; and while there would be more stems on the land, the growth on each tree would be little. In some species of conifers, such as white pine, the natural competition of the trees for food in the soil and for light overhead reduces, without man's help, this number of trees to the acre. But Nature does this much too slowly, certainly not fast enough to give the best conditions for tree growth.

Thinning is also a form of insurance that the plantation crop will come through a critical period. When plantations are from 15 to 30 years of age, all the crowns of evergreen branches are usually at the same level. Wind following heavy, wet snowfalls on these crowns causes many stems to break. Sometimes as much as ¼- to 1-acre blocks are broken over. Insects and disease are more damaging in dense, stagnated stands.

The theory of thinnings in the growing plantation is to reduce mechanically the number of stems per acre, so progressively more and more wood is put on fewer and fewer trees. On any one acre of soil, there is only a given amount of food which the trees with the help of sunshine will convert into wood to be stored on the trunk. The question you must answer is: "Shall that food be stored in the very thin annual ring on perhaps 600 or 700 trees per acre, or is it better to double the width of the annual ring by reducing the number of trees by half?"

There is a tendency now, in the light of the experience of the past twenty years, to get still farther away from the European practice of 3- by 3-feet spacing, and to plant trees as far apart as 8 by 8 feet, or 10 by 10 feet. The information in this bulletin, however, is directed principally to the owner who has a plantation spaced 6 by 6 feet, or 5 by 5 feet, and that obviously needs thinning.

When to thin

There are two approaches to the question as to when you should thin your plantation. One is, perhaps, theoretical; the other is practical.

The theoretical answer is to start thinning when the dominant trees in the stand start to slow up their diameter growth rate. There is a distinct relationship between the depth of live crown and the amount of wood being laid on the stem in annual rings of growth. If you cut a thrifty tree in a ten-year-old red pine plantation, you will note that the annual rings of growth are ⅛ inch or more apart. That is radius growth, of course, so diameter growth is ¼ inch, and the red pine is growing in diameter at the rate of 1 inch every four years. That is understandable, because the red pine that you just cut down has a live crown for well over half of its total height. But, now examine a twenty-year-old stump in a red pine stand of the same spacing. The growth rings on the outside are narrower now, and a glance at the nearby standing trees shows dead branches more than halfway to the top of a 36-foot tree. The live crown, through competition, has been reduced to less than half of the total height of the tree. It can be said: "Start thinning when the thrifty trees in the middle of the planta-

tion show that there is less than 40 per cent of the total height left in live crown." Suppose there is no market or use for the trees you remove. Theoretically, the thinning should be done anyway, even if it involves leaving the felled trees in the plantation. The cost of this thinning is an investment that pays off in a greater and better final harvest. You may reduce this investment cost, when there is no market for the thinnings, by killing the trees by girdling or by injecting chemicals into the stems of trees.

The practical answer to your question: "When will I thin?" is simple. When you find a market or a use for the material removed that will at least pay the cost of cutting and removal, even if it does not allow you any stumpage, thin your plantation. Stumpage is the value of a forest product while still standing in the tree, before you have done any work.

Obviously, the practical time to thin will always be later than the theoretical, because the trees you take out will be larger in size and thus have a greater value. It should be pointed out, however, that practice is being pushed back toward theory as the possibilities of utilization of the thinnings is being explored and developed. Treated fence posts take trees with a 3-inch top. Even smaller sizes with greater length can go into rustic work and trellises if treated with the proper wood preservatives.[2] Gradual thinnings result in uniform ring growth, as opposed to the infrequent thinnings which result in distinct bands of wide and narrow ring growth. Pulpwood absorbs increasing quantities of the thinnings for three excellent and obvious reasons: 1. Softwoods (conifers) are preferred by most pulp companies, and these companies pay more, and go farther afield, to be assured of a continuing supply. 2. Chemical means of killing the trees, so the bark will fall off within a year's time, is now beyond the experimental stage and will greatly reduce the cost of producing bark-free wood for pulpwood or fence posts. 3. Effective mechanization of cutting into 4-foot sections, and loading on trucks, is being perfected, and such equipment is now being put on the market in New York State.

The palisades type of construction for storage sheds, outhouses, and cabins, using pole-sized trees, is described in Cornell Extension Bulletin 747, *Home-Grown Lumber for Farm Buildings,* and represents another possible use for thinnings from your forest plantation. Pole-barn construction may also use some thinnings if the poles are treated for longer life.

Still another promising use of these thinnings from forest plantations is for bedding and mulch when processed through a portable wood chipper.

How much to thin

Observations of the managed plantations around the State indicate that most thinnings have been too late and too little (page 4). The too little is of equal or even greater significance than too late. The object of thinning, it will be remembered, is to concentrate the growth rate on progressively fewer trees. It takes plenty of crown area to do this. If the thinning is so late that the most vigorous trees may have only a quarter of total height in live crown, then the thinning must be drastic if the remaining trees are to have the space or room to develop a greater length of live crown. Heavy thinning actually stops the death of side branches. You must be prepared to remove from 30 to 35 per cent

[2]Further details may be obtained by writing the Extension Forester, New York State College of Agriculture, Cornell University, Ithaca, New York.

Figure 1. This 17-year-old stand pruned and thinned three years ago will need to be pruned and thinned more in two years.

of the live stems on each acre if thinning is to benefit the remaining trees. For example, in an actual white pine plantation, spaced 6 by 6 feet, established in 1912, there was a high survival because of good planting practices. By the time the crowns closed in 1920 there were almost 1200 trees to the acre. At the first thinning, made in 1937 at an age of 25 years, 1116 trees to the acre were still standing although 100 were dead. The thinning took out 384 live trees and 100 dead trees per acre—43 per cent by number but only 35 per cent by volume. That still left 632 trees per acre—more than twice the number needed for a high yielding stand at maturity.

The mechanics of thinning

Theoretically, the best way to make this thinning in your plantation is to pick out about 300 trees per acre and mark them as crop trees. That is more than you will need for the ultimate harvest, but the extra ones—an "insurance policy"—can be taken out in later thinnings. To ensure even distribution of these 300 trees, go down the rows and take every other tree in every other row, and mark that tree with a dab of paint or with a string. If this mechanical selection happens to include an obviously inferior tree, as to its form, health, and vigor, then go to the next tree in the row or a tree in the adjoining row that was skipped, and select one of these. If the original spacing was 6 by 6 feet, this provides 300 crop trees. The thinning helps each crop tree by cutting a competing neighbor, usually on the south or west side. This takes out approximately 300 trees per acre, or about one-third of the stand if your stand runs around 900 trees to the acre.

On large-scale operations, you can readily appreciate that there are practical difficulties in getting the thinnings out of the plantation on any such cutting scheme. It has been found a good practice, therefore, to reduce the number of stems per acre by removing every third row. This serves a double purpose: (1) it obviates the necessity of marking the crop trees at the time of the first thinning, and (2) it makes it much easier to fell the trees. You start at one end of the row and fell each succeeding tree in the row in the direction and on top of the others. It is also easier to skid out the tree-length poles to a suitable place for bucking into the required lengths.

Subsequent thinnings

Once the thinning procedure has been started in a plantation, it is important to keep it up. Usually, at 5-year intervals the crowns are again closing in and the side branches are beginning to die. No such volume, as is entailed in the first thinning, is taken out in these subsequent operations. For example, in the white pine plantation established in 1912 (described above), the first thinning made at an age of 25, took out 35 per cent by volume of the existing stand. The next thinning, made in 1942, reduced the crop trees to 268, and took out enough of the remaining unmarked (filler) trees to make a total of 104 (18 per cent by number, and 17 per cent by volume). There were still left on the acre enough trees (472) to keep the ground well shaded to prevent growth of briars or hardwood seedlings. In 1950, the stand had 256 crop trees. A third thinning, together with a wind storm, made a heavier reduction in stems per acre than was calculated, but still with that number of stems per acre there are no briars and no seeding of hardwoods.

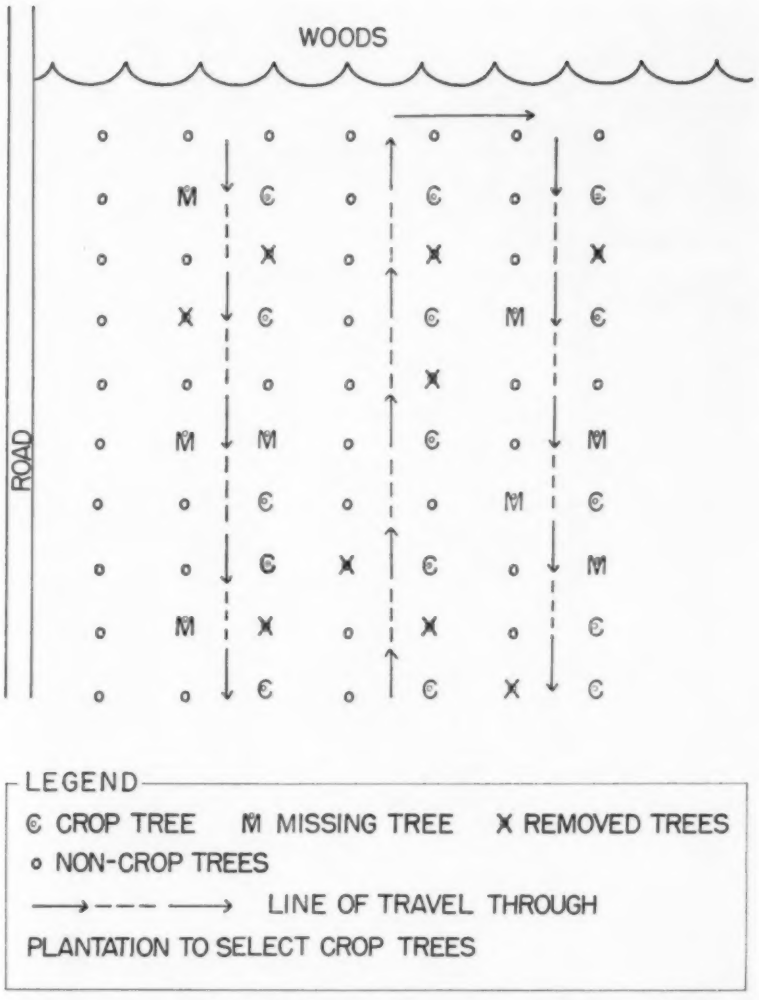

Figure 2. By mechanically selecting every other tree in every other row, from 250 to 300 crop trees may be selected to the acre. If for some reason the tree picked mechanically is unsatisfactory, select another as shown here.

Figure 3. The outside row of trees in the plantation should remain untouched to prevent wind from drying out the forest floor.

When you thin by the removal of every third row, straight through the plantation, subsequent thinnings will obviously call for helping the best of the remaining 66 per cent of the stand. It might be well, even at this late date, to designate not more than 40 per cent of your remaining trees as crop trees, so this second thinning would help them as in the other type of marking for thinning.

In general, it may be said that thinnings in plantations in New York State, whether first or subsequent, are made from below. That is, the poorest trees as to form, size and vigor, are removed, leaving the more vigorous, better-formed trees *as long as they are not too coarse*. A coarse tree may be defined as one with large, vigorous branches, 2 inches or more in diameter where attached to the central stem.

The one possible exception to this general rule is in the solidly planted lots of white pine where the white pine weevil has caused considerable damage. Invariably, in such plantations, the largest trees are multiple-stemmed due to weevil injury and are crooked and excessively limby, whereas the smaller trees in the row that have escaped excessive weevil damage are reasonably straight and of good form. If there are enough good stems to make a decent stand (200), thinning will necessarily be "from above," taking out these excessively large dominant trees or at least girdling them so that they need no longer compete with the better trees below.

Figure 4. This 25-year-old red-pine plantation was row-thinned four years ago. Crop trees should be selected and a thinning made within three years. No pruning was done in this stand.

Figure 5. Correct pruning technique removes the whole branch and a small part of the bark (shoulder) to insure rapid healing of the wound.

Figure 6. Section of pruned red pine showing healed-over area.

PRUNING

Thinning is directed toward increasing diameter growth on successively few trees. Pruning, or the removal of side branches, has no effect on volume but is related to value. As long as there are branches on the stems of the trees, whether these branches are alive or dead, the resultant lumber sawed from those stems will be knotty. Whereas, if you removed the branches, then the new growth is put on over the stub, provided it is pruned closely, and from then on clear lumber as far as that particular knot is concerned is produced. In most instances, clear lumber—that is, knot-free lumber—commands a higher price than lumber with knots. If this is the case, then your expenditure of time or money in pruning to the height of the first log may well pay you a handsome profit in the increased value of the final crop. In some sections of the Northeast there was, prior to World War II, a difference of more than $100 a thousand board feet between clear, white pine and lower grades with knots and other defects.

Such pruning should, of course, be confined to those crop trees that deserve special help. You should not spend time and effort to make knot-free lumber on trees that will be taken out in the second or third thinnings, and thus never have an appreciable amount of clear wood over the knots. This is sound reasoning. However, the care and convenience in carrying on any cultural operations in your plantation is a consideration.

Practically all the coniferous trees, in New York plantations, have side branches that persist long after they are dead. If you have ever tried to penetrate the interior of a 20-year-old plantation, you know exactly what these persistent

dead branches are. You need a leather jacket, as well as facial protection, to progress through such a plantation. It is obvious, therefore, that the first pruning you do should coincide with the first thinning. The crop trees should be pruned thoroughly at this time, and the remaining trees—not to be considered crop trees—should be limbed out enough to make first and subsequent thinnings easy. Many plantation owners have done a more thorough job in pruning than is necessary, merely for easy access to their plantations.

When to prune

If considered in a point of time sequence, pruning really precedes thinning. Thinning is not started until the depth of the live crown has been reduced to 40 per cent. Thus, a 20-foot tree with 10 feet of dead branches is not yet ready for thinning, but is certainly ready for pruning. In fact, the rule is that you should start pruning when the dead branches have proceeded up the stem to approximately head height. In a 6-by-6 spacing of red pine, for example, this is when the trees are from 15 to 20 years old, and the stem diameters are about 4 inches at breast height. If you thin your stand by the crop-tree method, then you certainly can select and prune your crop trees at the same time.

If you thin your stand by the row method, then it might be advantageous for you to wait—from the standpoint of economy of time and temper—until the rows of trees have been removed. Then proceed to prune on not more than half the trees in the intervening two rows.

Field studies have shown that more than one-half of the quality lumber in any given tree is in the first 16-foot log. Therefore, subsequent prunings will not go beyond the first log length, and you should confine this pruning definitely to those selected crop trees. In actual practice, it has been found best to do the first pruning when the dead branches extend slightly above head height. At this time, the trees are approximately 4 inches in diameter at breast height, and the live limbs are still small in diameter. The first pruning removes all the dead branches flush with the bark of the tree, and continues upwards to remove one whorl of live branches. The removal of one whorl of live branches postpones the need to return to pruning the plantation for a number of years. Usually, this whorl of green branches is not vigorous, and will naturally die at an early date anyway.

Figure 7. If stub is left, the tree must grow for some years before the wound heals.

Finally, after a lapse of a few years, continue the pruning upwards to remove all the dead branches, again removing one whorl of green branches. Continue this process until the top of the first log, or the 17-foot point, is reached. The additional 1 foot is allowed for stump height.

You might well ask: "Why not do all the pruning at one time and have it over with?" There is one reason why it is better to do the pruning in at least three stages. If you waited until the branches were dead to the 17-foot point or thereabouts, and the stems at that point were 4 inches in diameter, then the diameter of the stem at the base of the log might easily be from 6 to 10 inches and the trunk would still be producing knotty lumber because of the dead but persistent side branches. Thus, when your tree was eventually cut and the butt log taken to the mill, the core of knotty lumber would not be uniform in thickness. There would be greater clear length at the top of the log than at the butt. You would also have to wait a longer time for the clear lumber to form on the base of the log than if it were done earlier in the life of the stand.

Mechanics of pruning

A curved pruning saw, cutting on the pull stroke, is a satisfactory tool. Other experienced woods' workers claim that a good pair of long-handled pruning shears, such as are used in orchard work, is more rapid and less tiring for a steady day's work. You can try both tools and arrive at your preferred choice. One advantage of the pruning saw is the closeness to the trunk of the resulting pruning job. This is most important. If you leave a quarter-inch stub, the tree must grow out and cover over this stub before knot-free wood can be laid on the trunk. You can cut very close with the pruner, but it is easy to be careless and leave a longer stub. In fact, for quick growing over of the cut, especially in a dead limb, it is well to take off a bit of the projecting bark around the branch being removed. This is easy to do when you use a saw, but not so easy with the pruners.

In the second and third pruning jobs, you must of necessity use a saw. If you prefer to stand on the ground, you can prune with a pole saw or a pruning saw placed in an axe handle or you can use a small light ladder that you can move quickly from tree to tree.

Unless there is a tremendous fire hazard in the area in which you are working, you may leave the pruned branches just where they fall. They will not rot so quickly as the hardwood brush, but snow and breakage from subsequent woods operations soon make them a part of the top layer of the forest floor. In time, they decay and add humus to the soil.

Questions always arise as to whether to prune live branches. In the interior of the plantation, it makes little or no difference in subsequent growth if you remove one whorl of live branches in the pruning job. In fact, the area where a live branch was removed heals over more readily than that of a dead branch. As long as the tree has 40 per cent or more of its total height in live crown, it maintains its maximum rate of diameter growth. The one place not to prune live branches is on the border of your plantation. Here, they remain green for many years because of the available light. If you should remove those branches and the wind sweeps into the plantation, the forest floor becomes dry and slows down the plantation growth.

Why prune

If there is no greater value in clear than in knotty lumber, then it is obvious that you are wasting your time and effort to prune. Woodland owners have often asked whether to prune hemlock trees. This may be a wasted effort, because hemlock, at its best, is a construction lumber, and clear hemlock brings little

Figure 8. Pruning and thinning have been accomplished. Tree 2 has been treated with chemicals to make peeling easy; tree 4 has been felled; trees 1, 3, 5, are crop trees.

Figure 9. This Norway Spruce pruned to 17 feet with a pole pruner will produce high-quality saw timber on a small core of knotty timber.

more than lumber covered with fine knots that come from the tiny branches of hemlock growing in dense shady stands. Again, if your forest plantation is to be harvested as pulpwood exclusively, and not as saw logs, then pruning will be an uneconomical use of your time and effort. If you prune your plantation in these instances, you must justify it on the basis of: (1) the ease of subsequent working to thin the plantation and (2) the general satisfaction you get from walking through a plantation where every tree stands out clean and is shorn of its useless dead branches.

IN BRIEF

A forest plantation, as the name implies, represents an investment in time and money for its establishment. You, as a farmer, do not neglect your field once it is planted, but continue the necessary cultural operations up to and including harvest. So must you, as a forest plantation owner, follow the same practice and weed, thin, and prune your plantation. Under most circumstances, the most important process is thinning. You can have a few competing and over-topping hardwoods in your plantation, and you will probably be not out too much financially if you do no pruning. The trees keep on adding volume even if the dead branches stay for 20 years or more, and they do. But, in the close-spaced plantations which have been common for the past thirty years in New York, thinning is a *must*. Even with a 4-foot spacing, the little trees start with 100 per cent of total height in live crown. This continues until the crowns close and the death of lower side branches begins. Gradually, this death of side branches increases up the stem at a faster rate than new growth is developed on top, so finally in your unthinned stand the trees arrive at a point where there is only 10 per cent of the total height in live crown, and the growth rings are subsequently as many as ten to the radial inch. Furthermore, "bean poles with feather dusters on top" whip in every passing breeze, breaking off new growth by contact with the crown of close-pressing neighbors. Such stands seldom, if ever, recover from this close growth and are easy prey to mechanical injury from snow, insects, and disease.

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